

# CAPI Working Group

## **Warm low clouds breakout report**

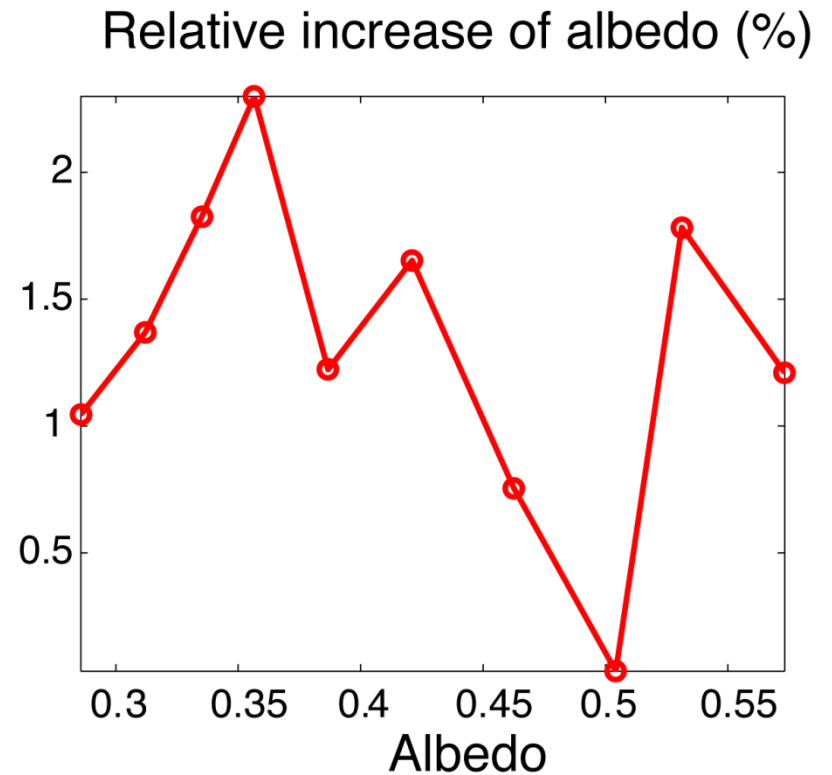
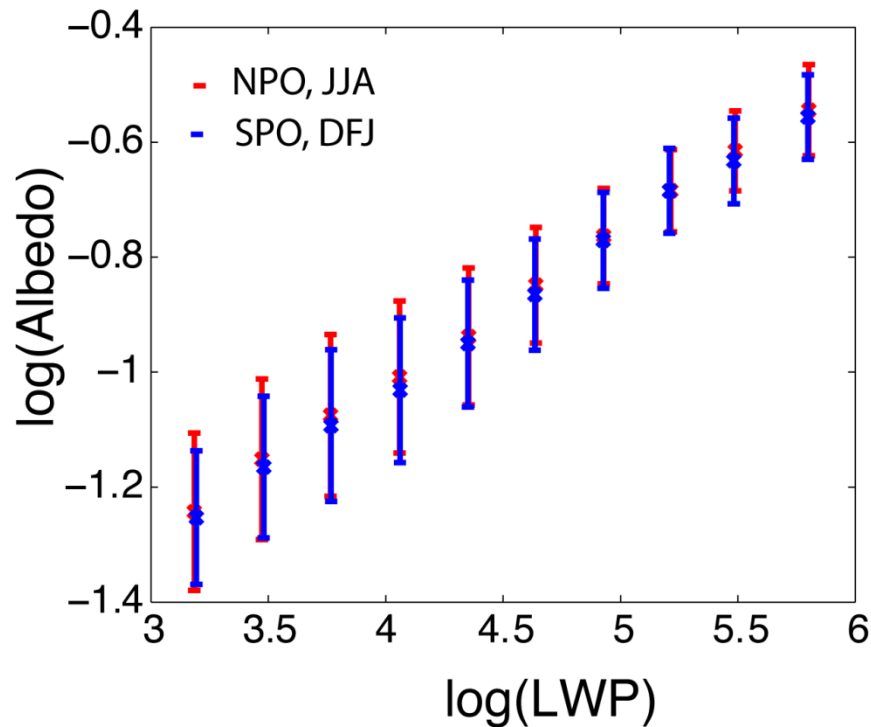


Lagoa das Sete Cidades (Lagoon of the Seven Cities), São Miguel, Azores

# Investigator presentations

- **Joyce Penner**
  - Scrutinized observations and models to assess whether GCMs overestimate AIEs
  - Cannot use PD data to estimate PD-PI
  - Hemispheric differences in clouds may not support low AIEs
- **Cheng Zhou**
  - Running CAM 5.3 and using it to force CRM to compare
  - Significant resolution dependence of LWP in CRM
  - Opportunities to join with observational groups for constraints
- **Xiquan Dong**
  - Compared low cloud properties at SGP and Azores
  - Contrasts in seasonality, microphysics, diurnal cycle
  - Observations to constrain large scale models
- **Jim Hudson**
  - Compared CCN-drop concentration ( $N_d$ ) closure in four field experiments
  - Two marine Sc (MASE, POST); two trade Cu (RICO, ICE-T)
  - Addition of spectral CCN info and vertical velocity improves regression between aerosols and  $N_d$

## Joyce Penner: Estimate “albedo effect” by normalizing to fixed LWP:



### Albedo effect: (first indirect effect):

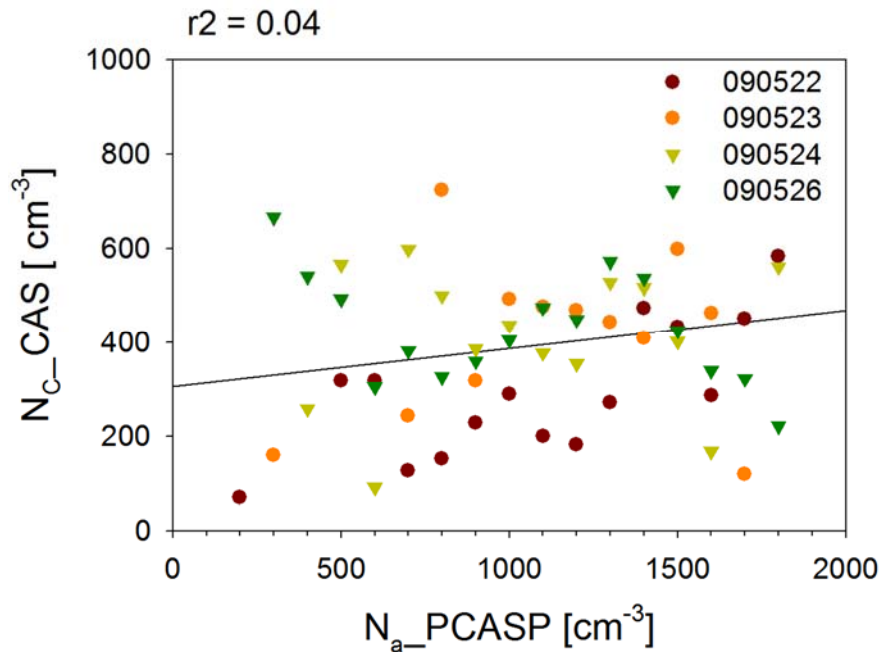
change in cloudy sky albedo  $\times$  cloud fraction  $\times$  solar insolation  
= -1.8 to -2.2  $\text{Wm}^{-2}$  (range for  $f > 0.5\%$  to  $f > 0.99\%$ );

Compare to Model: -2.65  $\text{Wm}^{-2}$  or -3.6  $\text{Wm}^{-2}$  (w/same methodology)

# Investigator presentations

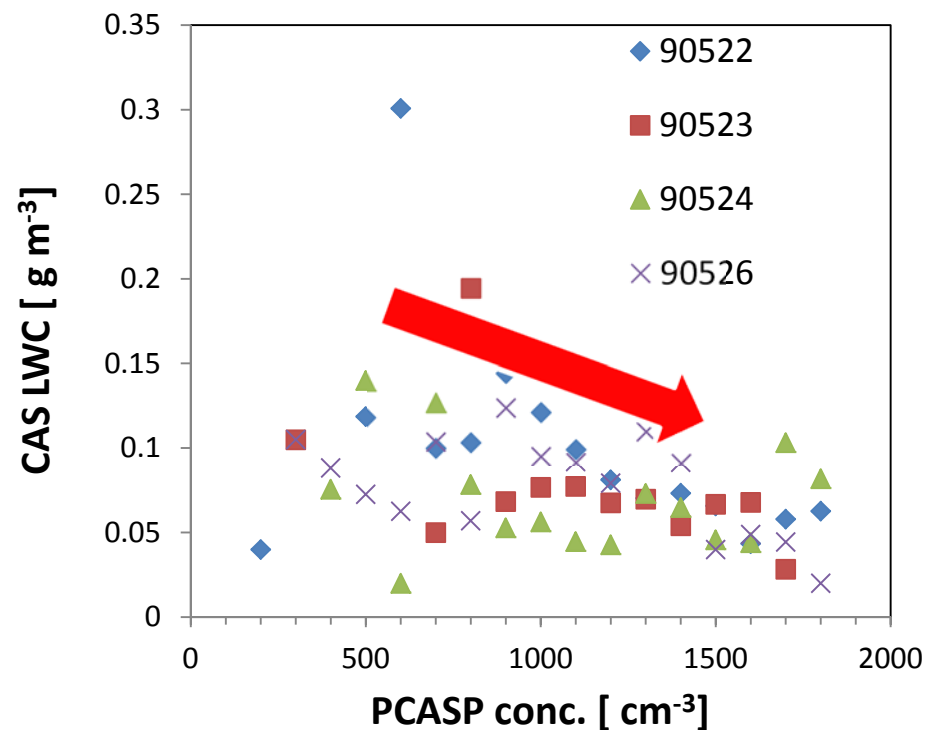
- **Alexander Marshak**
  - Use range of satellite, Aeronet and ARM data to examine cloud-clear transition zone
  - Half of all clear sky regions globally are within 5 km of cloud
  - Increased scattering extends out several km from cloud
- **Yangang Liu**
  - Re-examination of dispersion effect (mitigation of Twomey as droplet dispersion increases with aerosol concentration)
  - Consideration of more realistic supersaturation spectral shape can result in dispersion decreasing or increasing with aerosol concentration
- **Greg McFarquhar**
  - Analysis of many Cu penetrations in RACORO indicate increasing  $N_d$  with  $N_a$ , but also decreasing LWC with  $N_a$
  - Results suggest move from heterogeneous to homogeneous mixing with height
- **Jan Kazil**
  - Examined impact of open cell clouds on surface heat fluxes in LES
  - Optically thick cloud produces cold pools that increase surface sensible flux that is conducive to maintenance of open cells

# Warm cumulus (RACORO)



Cloud droplet concs increase with aerosol concs, but lots of scatter. Updraft strength more predictive?

Cloud LWP decreases with aerosol. Why?



Greg McFarquhar

# Measurement/retrieval needs

- **LWP**
  - Improved multi-channel retrievals (near-term)
  - Wetting problems getting resolved
  - Separation of cloud and precipitation water using combination of different sensors
- **Cloud effective radius and droplet concentration**
  - Several groups producing retrievals but need to assess agreement and need for ground truth
- **Light precipitation**
  - New use of Doppler spectral information in cloud to separate clouds from drizzle
- **Entrainment**
  - New estimates from radar
- **New approaches to sampling 3D clouds from surface**
  - Scanning radars and surface radiometry

# Field experiments

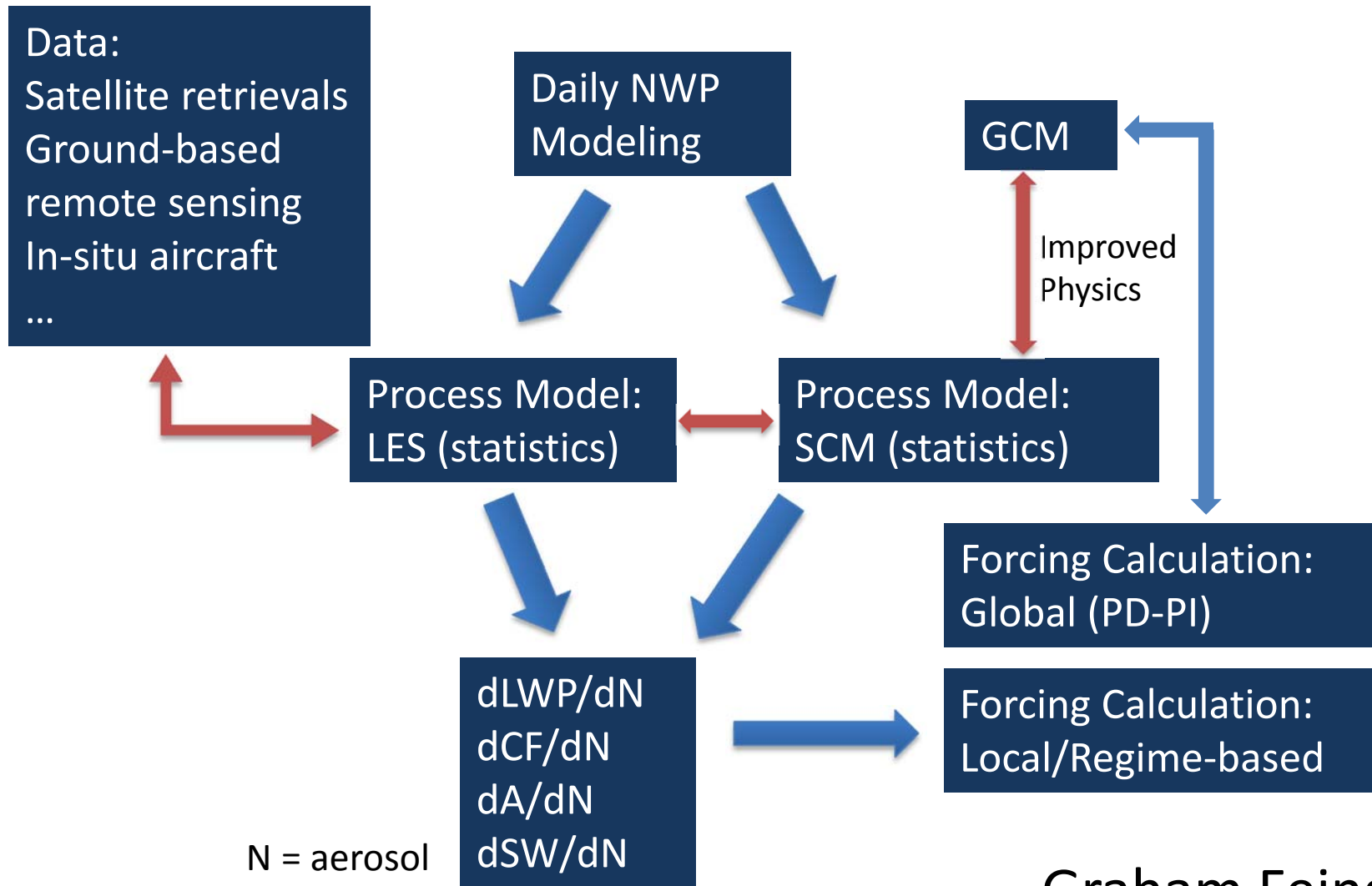
- **RACORO** [synergy with ALC, CLC]
  - 5 months regular sampling of clouds over SGP. Sc and Cu sampled with excellent cloud microphysics, aerosols, hygroscopicity
- **T-CAP** [synergy with ALC]
  - Wealth of information on aerosol vertical structure and connection between column aerosol and surface CCN properties
- **Go-AMAZON** [synergy with ALC, CLC]
  - Will produce wealth of data on shallow Amazonian clouds and impact of aerosol thereon
- **Azores aircraft campaign** [synergy with CLC]
  - Ground truth for cloud droplet concentration estimates
  - Relationship between surface and cloud base CCN
  - Entrainment impacts on cloud structure
- **CORMORANT** [synergy with ALC, CLC]
  - Measurements of marine trade Cu to examine factors controlling cloud cover
- **Southern Ocean (SOCRATES)** [synergy with ALC, CLC]
  - Provides proxies for preindustrial conditions for constraining climate models

# Focus group idea

- **Testing low clouds in models against observations using low cloud “testbed”**
  - Use global or regional climate model run in CAPT or nudged mode to drive single column (continuously) and LES models (for particular cases)
  - Models can be tested against observations and used to explore sensitivities to assumptions about aerosols (PD vs PI or different emissions scenarios, aerosol processing/transport assumptions)
  - Ties in with objectives for CLC warm, low clouds group



# Test Bed Approach



Graham Feingold